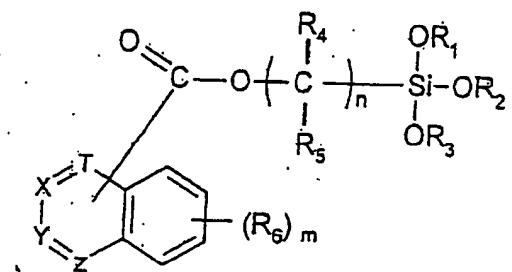


Claims

- Method for the preparation of a silyl alkyl ester having the Formula (I)



(I)

in which.

R<sub>1</sub>, R<sub>2</sub>, and R<sub>3</sub> are equal or different and represent alkyl, aryl and heteroaryl,

R<sub>4</sub> and R<sub>5</sub> are equal or different and represent hydrogen, halogen, alkyl, aryl and heteroaryl,

n is an integer from 1 to 10,

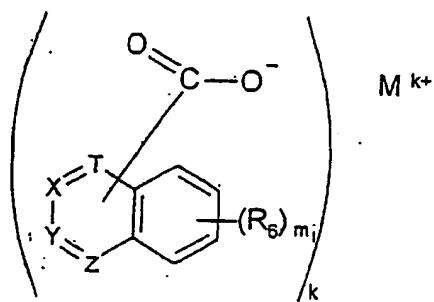
R<sub>6</sub> is a substituent selected from halogen, alkyl, aryl, heteroaryl, hydroxy, alkoxy, arylether, substituted and unsubstituted amino group, carboxy group, carboxylic acid ester group, carboxylic acid amide group, sulfonic acid group, sulfonic acid ester group, sulfonyl, thio, thioether and nitro,

m is an integer from 0 to 4,

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T, X, Y and Z each represent carbon,  
a benzo group, which is m-fold substituted with R<sub>6</sub> or  
which is unsubstituted, is condensed on one of the bonds  
T-X, X-Y or Y-Z to form a trinuclear aromatic ring system,  
wherein the silyl alkyl ester group is substituted at the  
middle ring of said trinuclear aromatic ring system,

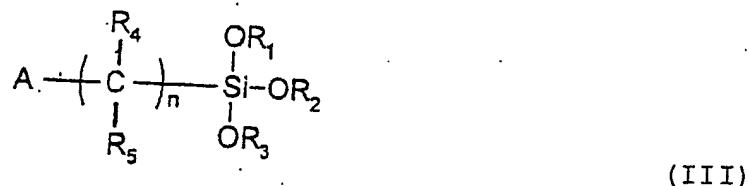
wherein a carboxylic acid salt of Formula (II)



(II)

in which k is an integer from 1 to 4 and M is a metal,

is reacted with an organosilicon compound of Formula (III)

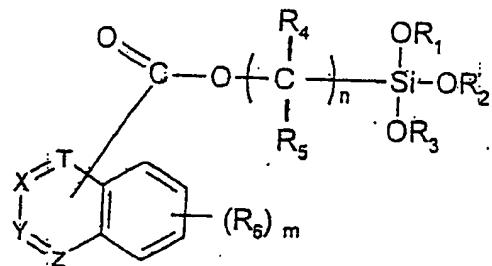


in which A represents a nucleofugal leaving group.

2. Method according to Claim 1, wherein the metal M is selected from the groups Ia, IIa, IIIa, IVa, Ib, IIb, IVb and VIIb of the periodic table.
  3. Method according to Claim 1 or 2, wherein k = 1.
  4. Method according to any one of Claims 1 to 3, wherein M is selected from metals of Group Ia.
  5. Method according to any one of Claims 1 to 4 wherein the metal M is selected from lithium, sodium and potassium.
  6. Method according to any one of Claims 1 to 5 wherein the metal M is sodium and/or potassium and particularly potassium.
  7. Method according to any one of Claims 1 to 6 wherein the nucleofugal leaving group A represents halogen, preferably chlorine and/or bromine and yet more preferably chlorine.

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8. Method according to any one of Claims 1 to 7 wherein the carboxylic acid salt of Formula (II) is reacted with the organosilicon compound of Formula (III) in a solvent or solvent mixture, from which the metal salt of the formula  $M A_k$  formed is precipitated.
9. Method according to Claim 8, wherein as solvent or solvent mixture, N,N-dimethylformamide and/or N,N-dimethylacetamide is used.
10. Silyl alkyl ester having the formula (I)



(I)

**wherein**

R<sub>1</sub>, R<sub>2</sub>, and R<sub>3</sub> are equal or different and represent alkyl, aryl and heteroaryl,

R<sub>4</sub> and R<sub>5</sub> each represent hydrogen,

n is an integer from 3 to 5,

R<sub>6</sub> is a substituent selected from halogen, alkyl, aryl, heteroaryl, hydroxy, alkoxy, aryloether, substituted and unsubstituted amino group, carboxy group, carboxylic acid ester group, carboxylic acid amide group, sulfonic acid

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group, sulfonic acid ester group, sulfonyl, thio, thioether and nitro,

m is an integer from 0 to 4,

T, X, Y and Z each represent carbon,

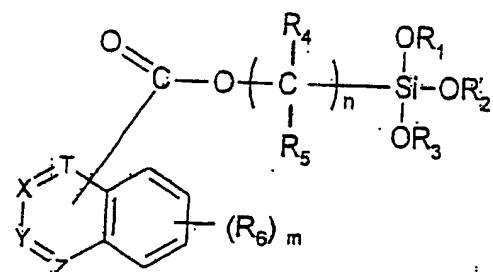
a benzo group, which is substituted m-fold with R<sub>6</sub> or which is unsubstituted, is condensed on one of the bonds T-X, X-Y or Y-Z to form a trinuclear aromatic ring system, wherein the silyl alkyl ester group is substituted at the middle ring of said trinuclear aromatic ring system.

11. Silyl alkyl ester according to Claim 10, **wherein R<sub>1</sub>, R<sub>2</sub>, and R<sub>3</sub> each represent alkyl.**
12. Silyl alkyl ester according to Claim 10 or 11, **wherein R<sub>1</sub>, R<sub>2</sub>, and R<sub>3</sub> are selected, independently of one another, from methyl, ethyl, n-propyl, iso-propyl, n-butyl, 2-methylpropyl, 1-methylpropyl and 1,1-dimethylethyl.**
13. Silyl alkyl ester according to any one of Claims 10 to 12, **wherein R<sub>1</sub>, R<sub>2</sub>, and R<sub>3</sub> each represent methyl or ethyl.**
14. Silyl alkyl ester according to any one of Claims 10 to 13, **wherein a benzo group, which is m-fold substituted with R<sub>6</sub> or which is unsubstituted, is condensed on the X-Y bond.**
15. Silyl alkyl ester according to Claim 14, **wherein an unsubstituted benzo group is condensed on the X-Y bond and m=0.**
16. Silyl alkyl ester according to any one of Claims 10 to 13, **wherein a benzo group, which is m-fold substituted with R<sub>6</sub> or which is unsubstituted, is condensed on either the T-X or Y-Z bond.**

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17. Silyl alkyl ester according to Claim 16, wherein an unsubstituted benzo group is condensed on either the T-X or Y-Z bond and m=0.

18. Silyl alkyl ester having the formula (I)



(I)

wherein

R<sub>1</sub>, R<sub>2</sub>, and R<sub>3</sub> are equal or different and represent alkyl, aryl and heteroaryl,

R<sub>4</sub> and R<sub>5</sub> are equal or different and represent hydrogen, halogen, alkyl, aryl and heteroaryl,

n is an integer from 1 to 10,

R<sub>6</sub> is a substituent selected from halogen, alkyl, aryl, heteroaryl, hydroxy, alkoxy, arylether, substituted and unsubstituted amino group, carboxy group, carboxylic acid ester group, carboxylic acid amide group, sulfonic acid group, sulfonic acid ester group, sulfonyl, thio, thioether and nitro,

m is an integer from 0 to 4,

T, X, Y and Z each represent carbon,

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a benzo group, which is substituted m-fold with R<sub>6</sub> or which is unsubstituted, is condensed on either the T-X or Y-Z bond to form a trinuclear aromatic ring system, wherein the silyl alkyl ester group is substituted at the middle ring of said trinuclear aromatic ring system.

19. Silyl alkyl ester according to Claim 18, wherein R<sub>1</sub>, R<sub>2</sub>, and R<sub>3</sub> each represent alkyl.
20. Silyl alkyl ester according to Claim 18 or 19, wherein R<sub>1</sub>, R<sub>2</sub>, and R<sub>3</sub> are selected, independently of one another, from methyl, ethyl, n-propyl, iso-propyl, n-butyl, 2-methylpropyl, 1-methylpropyl and 1,1-dimethylethyl.
21. Silyl alkyl ester according to any one of Claims 18 to 20, wherein R<sub>1</sub>, R<sub>2</sub>, and R<sub>3</sub> each represent methyl or ethyl.
22. Silyl alkyl ester according to any one of Claims 18 to 21, wherein R<sub>4</sub> and R<sub>5</sub> each represent hydrogen.
23. Silyl alkyl ester according to any one of Claims 18 to 22, wherein n is an integer from 1 to 5, particularly from 1 to 3, yet more preferably 1 or 3 and most preferably 3.
24. Silyl alkyl ester according to any one of Claims 18 to 23, wherein an unsubstituted benzo group is condensed on either the T-X or Y-Z bond and m=0.
25. Composition which comprises at least one silyl alkyl ester according to any one of Claims 10 to 24 and at least one further reactive silane.
26. Composition according to Claim 25, wherein the reactive silane is selected from alkoxy silanes and halogen silanes, particularly chlorosilanes.

27. Composition according to Claim 25 or 26, **wherein** the reactive silane is selected from triethoxysilane (HTEOS), tetraethoxysilane (TEOS), methyltriethoxysilane (MTEOS), dimethyldiethoxysilane, tetramethoxysilane (TMOS), methyltrimethoxysilane (MTMOS), trimethoxysilane, dimethyldimethoxysilane, phenyltriethoxysilane (PTEOS), phenyltrimethoxysilane (PTMOS), diphenyldiethoxysilane, diphenyldimethoxysilane, trichlorosilane, methyltrichlorosilane, ethyltrichlorosilane, phenyltrichlorosilane, tetrachlorosilane, dichlorosilane, methyldichlorosilane, dimethyl-dichlorosilane, chlorotriethoxysilane, chlorotrimethoxysilane, chloromethyltriethoxysilane, chloroethyltriethoxysilane, chlorophenyltriethoxysilane, chloromethyltrimethoxysilane, chloroethyltrimethoxysilane and chlorophenyltrimethoxysilane.
28. Composition according to any one of Claims 25 to 27, **wherein** the reactive silane is selected from triethoxysilane (HTEOS), tetraethoxysilane (TEOS), methyltriethoxysilane (MTEOS), tetramethoxysilane (TMOS), methyltrimethoxysilane (MTMOS), phenyltriethoxysilane (PEOS) and phenyltrimethoxysilane (PTMOS).
29. Composition according to any one of Claims 25 to 28, **which** comprises a solvent or solvent mixture.
30. Composition according to Claim 29, **wherein** the solvent or solvent mixture comprises at least one component selected from water, linear or branched alkyl alcohol having 1 to 6 carbon atoms, linear or branched ketone having 1 to 6 carbon atoms, linear or branched carboxylic acid ester having 1 to 6 carbon atoms and linear or branched carboxylic acid amide having 1 to 6 carbon atoms.

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31. Composition according to Claim 29 or 30, **wherein** the solvent or solvent mixture comprises at least one component selected from water, acetone, 1-propanol, 2-propanol, butanol, methylisobutylketone, methoxypropanol, propoxypopropanol, ethyl acetate and propyl acetate.
32. Composition according to any one of Claims 25 to 31, **which** comprises an aqueous solution of at least one protonic acid and/or an aqueous solution of at least one acid anhydride.
33. Composition according to Claim 32, **wherein** the protonic acid is nitric acid.
34. Method for the preparation of a polysiloxane composition, **wherein** a composition according to any one of Claims 25 to 33 is provided and the silyl alkyl ester is condensed with the reactive silane.
35. Method according to Claim 34, **wherein** the condensation of the silyl alkyl ester with the reactive silane is carried out by heating.
36. Method according to Claim 35, **wherein** the composition is heated for 1 to 24 hours, more preferably for 1 to 10 hours and yet more preferably for 2 to 6 hours at a temperature of 20 to 100°C, more preferably from 40 to 80°C and yet more preferably from 60 to 80°C.
37. Method according to any one of Claims 34 to 36, **wherein** during the condensation, polysiloxane having a low molecular weight and degree of cross-linking is formed, which is dissolved or suspended in the solvent or solvent mixture.

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38. Method according to any one of Claims 34 to 37, **wherein** during or after the condensation, a diluting solvent is added.
39. Method according to Claim 38, **wherein** the diluting solvent comprises at least one component selected from methanol, ethanol, 2-propanol, butanol, acetone, propyl acetate, ethyl lactate, propylene glycol propyl ether, diacetone alcohol and methoxypropanol.
40. Polysiloxane composition, which is obtainable by a method as defined in any one of Claims 34 to 39.
41. Coated substrate, which is obtainable by a method comprising applying the composition as defined in any one of claims 25 to 33 or the polysiloxane composition as defined in claim 40 to the substrate and heating the substrate with the composition or polysiloxane composition applied thereon.
42. Coated substrate according to claim 41, **wherein** applying of said composition or said polysiloxane composition is performed by means of spin techniques.
43. Coated substrate according to claim 41 or 42, **wherein** the substrate is selected from a semiconductor device, a silicon-wafer, a glass plate and a metal plate.
44. Use of a composition as defined in any one of Claims 25 to 33 or of a polysiloxane composition as defined in Claim 40 for the preparation of a coating on a substrate.
45. Use according to Claim 44, **wherein** the composition or the polysiloxane composition is applied to the substrate and

the substrate with said composition or polysiloxane composition applied thereon is heated.

46. Use according to Claim 44 or 45, wherein the composition or the polysiloxane composition is applied to the substrate by means of spin techniques.

47. Use according to any one of Claims 44 to 46, wherein the substrate is a semiconductor device or a silicon wafer.

48. Method for the photolithographic production of an integrated circuit pattern comprising the steps of:

(a) radiating a stack through a mask, said stack comprising the lower substrate, an upper photoresist layer, at least one anti-reflective layer formed from the composition as defined in any one of claims 25 to 33 or from the polysiloxane composition as defined in claim 40, and optionally at least one further layer to be structured, each being located between said substrate and said photoresist layer,

(b) developing the exposed stack to produce openings in said photoresist layer,

(c) etching a first pattern through said openings in said at least one anti-reflective layer and optionally at least one further layer to be structured, and

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- (d) stripping off said photoresist layer, at least one anti-reflective layer and optionally at least one further layer to be structured to produce the integrated circuit pattern.
49. Method according to claim 48, wherein the substrate is a semi-conductor device or a silicon wafer.
50. Method according to claim 48 or 49, wherein in step (a) the stack is radiated with ultraviolet light having a wavelength of less than 260 nm, particularly 193 nm or 248 nm.